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Before the
Federal Communications Commission
Washington, D.C. 20554

In the Matter of	)	
	)	NPRM Docket No. 19-116
Allocation and Service Rules for the	)	
1675–1680 MHz Band	)	

Comments in Response to NPRM Docket No. 19-116

Introduction

Microcom Design renews its concerns that were originally stated in June 2016 in response to Docket RM-11681 (ID 60002152045) with regard to the sharing of the 1675-1680 MHz from 2016 for non-federal flexible wireless use. Since the statements of the original petitioner in the intervening years have done little to allay Microcom's concerns, Microcom commends the FCC in releasing an NPRM that seeks broad comment on a wide variety of topics to ensure that any potential sharing of this band is done so in a way that safeguards the incumbent users of the NOAA satellite downlinks.

Microcom shares the concerns of all those in the weather community about adjacent channel interference for the GOES Rebroadcast (GRB) and the High Rate Information Transmission (HRIT) in neighboring 1680-1695 MHz band. These satellite retransmissions of NOAA products are specifically intended to be consumed by a wide variety of both federal and non-federal users, and just became active within the last two years. The weather community is still in the early stages of realizing the potential these services can provide, but they are already serving the public. Any disruption to these services would, in Microcom's opinion be a detriment to the public interest of the citizens of this country, and other countries in this hemisphere.

However, Microcom's greatest concern is with regard to the Data Collection System (DCS), which is susceptible to co-channel interference since the bulk of the DCS downlink resides in the 1675-1680 MHz band.

With the relocation of Radiosondes out of the 1675-1680 MHz band, which as noted in the NPRM is scheduled to be completed in February of 2021, and the transition to the GOES-R series of satellites, Microcom recognizes that in the future, NOAA's use of 1675-1680 MHz will be quite limited. Therefore it does make sense to look for ways to make more efficient use of this small piece of spectrum, provided it can be done so in a way that preserves these critical pieces of weather infrastructure (DCS, GRB, and HRIT) that serve the public interest as required of the Commission and the NTIA in accordance with the Congressional RAY BAUM'S Act of 2018 as noted paragraph II.7 of the NPRM.

As a DCS ground station support contractor, Microcom is also aware of the ongoing Spectrum Pipeline Reallocation Engineering Study (SPRES) being performed by NOAA, referenced in the NPRM, and scheduled to be completed around the first quarter of 2020. Since Microcom understands that many of the topics the Commission requests comment on in the NPRM are being addressed under SPRES project, Microcom believes it is in the best interest of the public to wait until NOAA has completed the SPRES project and submits its findings before any final determination as to whether 1678-1680 can be safely shared, and if so how this can best be achieved.

Notwithstanding, Microcom would like to offer the following comments which we feel strike a balance between protecting the incumbent users from interference while providing the greatest amount of usable spectrum for new non-federal wireless industry use.

Incumbent Users and Harmful Interference

Section III.A.14 of the NPRM makes clear its intention “to protect incumbent (current and planned) federal operations from harmful interference” for which Microcom commends the Commission. Before discussing Microcom’s comments and recommendations on how to achieve this goal, Microcom would like to cite some specific examples as to why this is of such a critical need. The three spectrums shown in Figure 1 were captured by Microcom at the following three federal DCS receive sites that utilize Microcom receiving equipment:

1. The US Geological Survey (USGS) receive site at the Earth Resources and Science (EROS) Center in Sioux Falls, South Dakota.
2. The National Interagency Fire Center (NIFC) receive site in Boise, Idaho
3. The US Army Corp of Engineers (USACE) receive site at the Rock Island Arsenal in Rock Island, Illinois

Sioux Falls, South Dakota | Boise, Idaho | Rock Island, Illinois

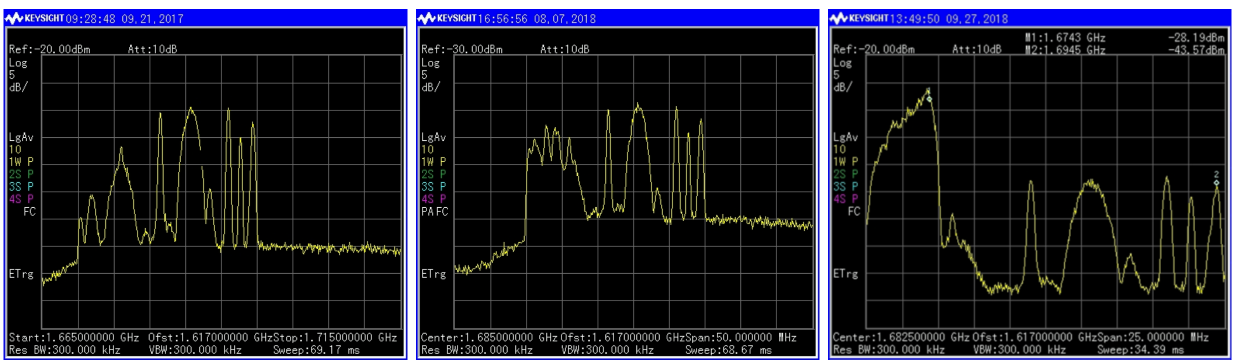

Figure 1: Existence of 1670-1675 MHz Signals in DCS Earth Stations

All of these spectrums show a significant level of the 1670-1675 MHz terrestrial signal getting into the earth stations at these sites. At the time these spectrums were captured, the NOAA downlink was still from the GOES-N series spacecraft and the terrestrial signal is clearly present near or impacting NOAA’s Sensor Data Downlink. While this interference was clearly impacting the GOES downlink, it was not affecting the DCS signal, which was located at the top of the NOAA band near 1695 MHz in the GOES-N spacecrafts (GOES-13 through GOES-15).

Now that NOAA has transitioned to the GOES-R series (presently just GOES-16 and GOES-17), the DCS signal occupies 1679.7-1680.1 MHz. If a terrestrially generated signal even as low as the one recorded at the USGS site in Sioux Falls were present, in a GOES-R downlink from 1675-1680 it would overlay the DCS and render the DCS unusable. The interfering signal captured at the USACE Rock Island site is over 15 dB stronger than any of the GOES downlinks and is getting close to a level that could completely overload the earth station receiver, and make it entirely inoperable; this is not only a concern for DCS earth stations, but also for GRB and HRIT earth stations.

Clearly this level of terrestrial signal getting into a satellite earth station should be of significant concern and should be considered when determining if the 1675-1680 MHz band should be shared at all; and if so, how to protect the incumbents from harmful interference.

Secondary not Co-Primary

In response to the request for comments from sections III.12, III.A.13, III.A.14, III.A.15 of the NPRM, Microcom believes that granting any new non-federal licensee of the 1675-1680 MHz band secondary status will better protect incumbent users. Further, from solely an interference perspective, co-primary status does not seem to make sense from the perspective of a new terrestrially generated transmission and an incumbent satellite generated transmission.

Clearly the potential for the terrestrial signal to interfere with the reception of the NOAA downlink earth stations is far greater than the potential for satellite downlink to interference with terrestrial receivers. As shown in Figure 1 above, the terrestrial signals being generated in the 1670-1675 MHz band are already readily present in several earth stations. The downlink signals (DCS, GRB and HRIT) presently being generated by the GOES spacecrafts can be received across the entire footprint of the satellites that virtually covers the entire Western Hemisphere. As such, the signal levels present at the earth's surface from these transmissions is consistent across a wide geographic area and cannot be altered without actually modifying the GOES satellite. As long as the NOAA satellites are functioning properly, the power spectral density of these downlinks will be met and there could be no justification for the incumbent licensee to perform any mitigation.

Any form of sharing will most likely place new burdens on the users of GOES earth stations that have previously never had to actively monitor for interference; terrestrial or otherwise. The first obvious burden is the financial costs of for monitoring and interference detection, but this is an inescapable reality in a spectrum sharing environment. All GOES receive sites will need to capture a baseline performance metric and then continuously monitor the spectrum and their system's performance for interference from new co-primary users. The incumbent GOES users will need the resources necessary to work on an established interference problem.

However, remediating interference problems is where Microcom's most significant concern with lies, and is the key basis for its recommendation for primary/secondary status versus co-primary; especially when the co-primary spectrum holders would be regulated by two separate federal agencies. Microcom's concern centers on how quickly interference of a protected earth station from the new terrestrial licensee can and will be mitigated. From Microcom's experience, non-NOAA GOES earth stations are quite often utilized when the data is critical and is used to protect life, property, and commerce. Microcom simply believes that placing a larger burden on the new licensee for remediation is a better approach then a co-equal standing, especially when resolving interference occurring at a critical earth station.

For nearly 40 years NOAA has provided the DCS on its spacecraft, as well as similar downlinks to GRB and HRIT, with great success and has continued to evolve its usage to ensure efficient use of its spectrum as new technologies become available. It is Microcom's opinion that the incumbent users of these critical NOAA downlinks be allowed to continue to do so and afforded the maximum protection under the Commission's rules in this new era of spectrum sharing, especially when the potential for one licensee to interfere with the other is so clearly one-sided.

Uplink not Downlink

Microcom's primary/secondary protection discussion notwithstanding, Microcom is certainly more concerned with the outcome of the NPRM process determining rules that minimize the potential for interference while maximizing the potential use of the spectrum. In response to requests for comments from sections III.B.16, III.C.22, III.C.23, III.E.44, III.E.1.45, III.E.1.46 of the NPRM, Microcom believes sharing the 1675-1680 MHz band can be more effectively and more safely done if the new licensee is limited to uplink use only as was done in the NOAA shared band from 1695-1710 MHz as part of the AWS-3 auction.

Based upon a simple line-of-sight analysis the protection zone around all current and future GOES receive sites can be decreased by a factor of about 45 if the transmissions are produced by a handset with 1 Watt of power versus a tower generating 2000 Watts. As such, restricting the ultimate licensee to uplink operation only will allow for a greater coverage area for the carrier(s) while best protecting the incumbent users.

Based upon test data collected at Microcom, a -11 dBm LTE signal radiating from an omnidirectional antenna located 250' away and 49º from the parabolic dish's bore site (see Figure 2) can begin to impact the noise floor of the DCS downlink in Microcom's corporate receive systems.

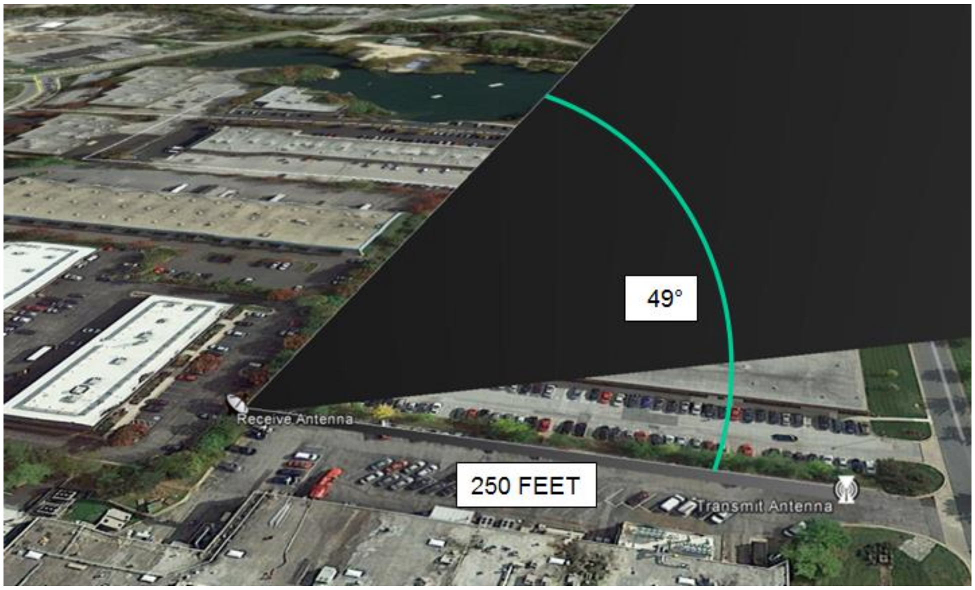

Figure 2: Microcom Interference Testing

Using this as a basis, and extrapolating to a 1 Watt transmission, suggests that the uplink protection zone radius could be as small as 28,000' or just 5.3 miles; although Microcom's calculations do not include any margin factor and were based on a fairly simple analysis. With D_1 = 250' and P_1 = -11 dBm = 0.079 milliwatts, using a line-of-sight calculation yields 28,050', or 5.3 miles, as shown below.

$$D_2 = D_1 * \sqrt[2]{P_2/P_1} = 250' * \sqrt[2]{1.0/0.079x10^{-3}} = 28{,}050' \sim 5.3\ miles$$

Conversely, a 2000 Watt EIRP tower would radiate over 20,000,000 times the RF energy as what Microcom showed could impact the DCS in its tests, and would obviously require much larger radius. Again, using the line-of-sight approximation would yield a downlink protection zone in excess of 200 miles.

$$D_2 = D_1 * \sqrt[2]{P_2/P_1} = 250' * \sqrt[2]{2000.0/0.079x10^{-3}} = 1{,}254{,}455' \sim 238\ miles$$

Such large protection zones would severely limit the utilization of the band on a geographic basis for a new licensee as shown in Figure 3. This diagram shows twelve 200 mile radius circles representing the potentially required zones to protect against co-channel interference from a high power downlink around each of the 13 federal DCS earth stations (two stations exist in Boise Idaho) known to Microcom and listed below.

1. NOAA Wallops Command and Data Acquisition Station – Wallops Island, VA
2. NOAA's Satellite Operations Facility – Suitland, MD
3. USGS at EROS – Sioux Falls, SD
4. National Interagency Fire Center – Boise, ID
5. US Bureau of Reclamation – Boise, ID
6. US Army Corp of Engineers – Rock Island, IL
7. US Army Corp of Engineers – Omaha, NE
8. US Army Corp of Engineers – Sacramento, CA
9. US Army Corp of Engineers – Vicksburg, MS
10. US Army Corp of Engineers – Columbus, MS
11. US Army Corp of Engineers – Cincinnati, OH
12. US Army Corp of Engineers – St. Louis, MO
13. NOAA National Estuarine Research Reserves System – Columbia, SC

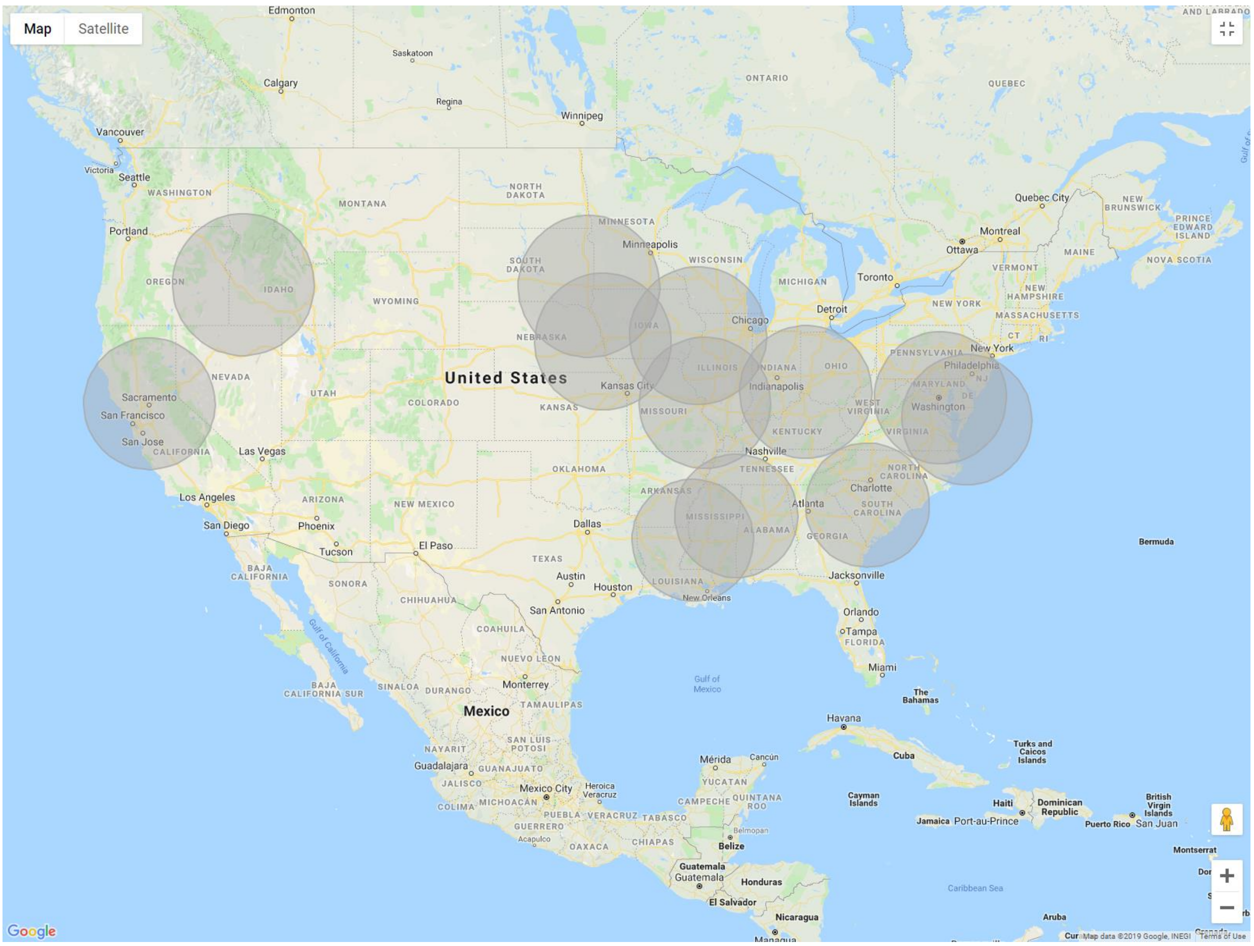

Figure 3: 200 Mile Radius Protection Zones for 13 Federal DCS Earth Station

In other words, if the band is allocated for uplink use and not downlink use, the economic value to non-federal new licensees of the areas around federal earth stations can be optimized. Further, Microcom believes that with the use of monitoring equipment, funded by any auction of the spectrum, the protection zones around these earth stations could be minimized dynamically, and automatically, to allow geo-fencing of subscriber units in near real-time. Given the use of multi-band channel aggregation by most non-federal users who operate cellular data and telephone networks, the geo-fencing approach would be used to switch to a different band of operation for uplink transmissions within the geo-fenced area, maintaining an uninterrupted communications experience for subscribers (consumers).

In contrast, if downlink use is permitted in the band, the fact that the DCS is co-channel and the nature of L-band propagation near 1680 MHz will obviously require very large static protection zones around all protected sites. Microcom recognizes that the line-of-sight calculation is simplistic and does not factor in topography, which could allow reductions in the protection zones, but it also does not account for the potential opposite situation. A well-known phenomenon, called “ducting”, can significantly extend the propagation of radio frequency signals beyond line-of-sight. Therefore, to ensure that during times of extended propagation conditions that the maximum levels of co-channel, and adjacent channel, interference are limited at federal earth stations, these protection zones may need to be even larger than the line-of-sight analysis.

One important topic that Microcom would like to reiterate and expand on is that interfering terrestrial signals can and will impact an earth station even though the transmitter is nowhere near the main receiving lobe of the parabolic dish. As noted above, and shown in Figure 2, the test signal Microcom radiated (under an experimental FCC license) could readily impact reception event though it was physically below the parabolic dish, and the dish was pointing into the sky at nearly a 45º elevation angle, resulting in being 49º off the bore site.

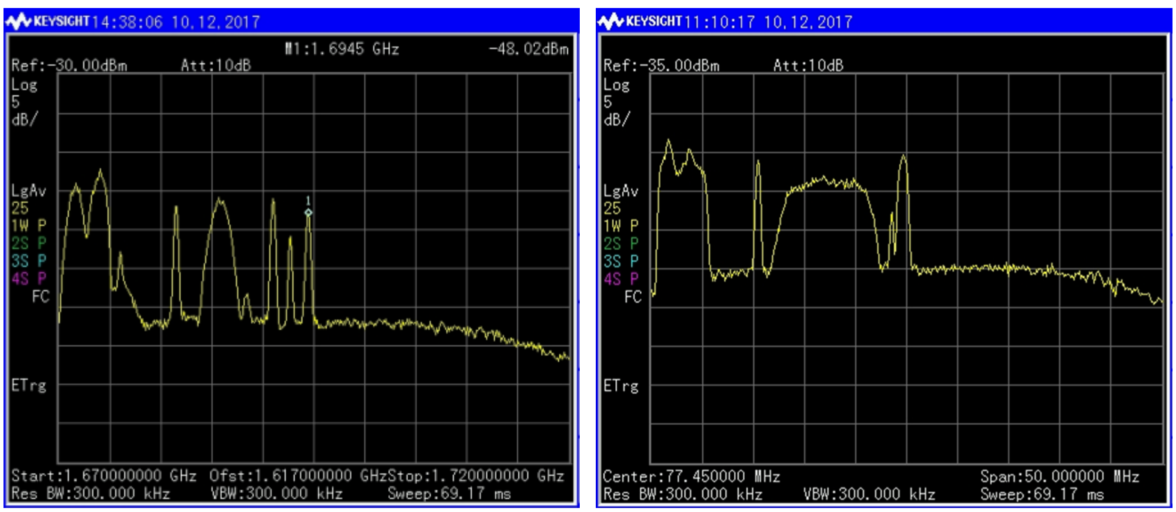

Figure 4: SFWMD 1670-1675 MHz Signal on Both GOES-13 (left) and GOES-16 (right)

As a second example of this phenomenon, the two spectrums above in Figure 4 were captured at a non-federal earth station at the South Florida Water Management District (SFWMD) in Boca Raton, Florida in October of 2017 just prior to GOES-16 replacing GOES-13 and taking over GOES-East operations. While Microcom was onsite performing some maintenance on SFWMD’s 5M parabolic dish, the strong 1670-1675 MHz signals were observed in the operational GOES-13 spectral downlink (left in Figure 4); similar to what was seen at the federal sites of Figure 1. Since GOES-16 was active at the time, but still at its test location of 89.5º West longitude above the equator, Microcom took the opportunity to also re-position the parabolic dish to point at the new satellite and capture the equivalent spectrum on the right. Note that even though the parabolic dish was re-pointed to a satellite nearly 15º away in the sky (the operational position of GOES-East is approximately 75º West longitude), the peak level of the interfering signal from 1670-1675 MHz is virtually identical (slightly greater than -45 dBm in both captured IF spectrums).

It is worth noting once again, that with the latest generation of GOES satellites, which are slated to fly out to 2036, the bulk of the DCS is contained within the band in question. As such, any DCS earth station experiencing an interfering signal in the 1675-1680 MHz equivalent to the interferer shown in Figure 4 would be rendered unusable.

Limit Frequency to be Utilized by the New Licensee

Based on the foregoing analysis and discussion, and in response to a call for comments from sections III.B.16, III.B.17, III.C.22, III.C.24, III.E.44 of the NPRM, Microcom respectfully suggests that the Commission give serious consideration to limiting the use of the band in question so as to change the potential for DCS interference from co-channel to adjacent channel.

By limiting the use of the spectrum to ensure that any new terrestrial signal is kept below 1679.7 MHz would mean the power in or near the DCS would have to meet specified out of band emission limits. For an LTE signal this would imply a minimum of 25 dB to 30 dB reduction in expected power based on the spectral emissions mask for this type of transmission.

Returning to Microcom's line-of-sight analysis, and assuming a 30 dB reduction in power limiting the frequency range of operation for the new licensee could potentially allow reducing the required protection zones by a factor of 31 (30 dB = 1000; $(1000)^{½}$ = 31). For an uplink signal, this could reduce the required protection zones to possibly 1000' or less (28,050'/31).

While the full 5 MHz is preferred, LTE can operate in 3 MHz, or even 1.4 MHz bandwidths. Utilizing just 1675-1678 MHz would certainly provide sufficient frequency separation to ensure adjacent channel operation of the DCS and any future license holder.

Should this be considered too restrictive and inefficient, Microcom's research has indicated that according to the 3RD Generation Partnership Project (3GPP) it is possible to use carrier aggregation to combine 3 MHz and 1.4 MHz LTE bands. While this needs to be thoroughly investigated and tested before putting into practice, this approach would decrease the band to be shared by just 0.6 MHz, or from 1675 to 1679.4 MHz. Since the DCS begins at 1679.7 MHz, the more desirable adjacent channel approach will have been achieved.

Clearly, reducing required protection zones will only serve to increase potential terrestrial utilization of the band; i.e. perhaps it makes sense to trade frequency utilization for geographical coverage.

Future Earth Stations

Microcom was encouraged by the language in paragraphs III.B.16, III.B.17, and III.B.18 of the NPRM that seeks comments on how current earth stations could be protected, and the request for comment on how future earth stations could be added. To this end, Microcom would respectfully suggest that smaller protection zones would address the Commission's request for comment in paragraph III.B.18 "on how to coordinate additional federal earth stations in the future." Smaller protection zones would certainly serve to simplify this process. Therefore, Microcom believes the best way to allow for future sites is the same as protecting existing sites: 1) limit the shared use to uplink only, and 2) limit the frequency to be utilized (at least until such time as NOAA has fully vacated the spectrum).

With regards to paragraph III.B.18 on identifying the locations of earth stations, Microcom promotes the creation of a database with the goal of facilitating coordination between the receive sites and the creation of protection zones by the carriers. Microcom would further recommend that the task of creating this database be given to NOAA to provide to the NTIA and the FCC. In some of Microcom's prior work with NOAA, Microcom assisted with the initial generation and population of such a database utilizing the DCS Administration and Data Dissemination System (DADDS) website. Microcom is also confident that generating a list of NOAA earth stations, if not creating a database, is one of the tasks in the SPRES project.

After a comprehensive database of earth stations has been established and is available, it can be used as a starting point for coordination of new earth stations. Microcom would support a program whereby any new earth stations to be added to the database must be coordinated with the new licensee. Further, if the geographical area in question is currently being used, or is in the planning stages of use, the agency wishing to deploy the earth station would be required to present its case to a governing body for the critical need to add the earth station and request a protection zone. Obviously smaller zones will make it easier to add new earth stations, whether they be for DCS, GRB or HRIT.

Federal versus Non-Federal

The NPRM shows that the Commission is aware of the critical nature of the data flowing through the GOES system and is also aware of the existence of non-federal earth stations. In response to paragraph III.B.19 it is Microcoms assertion that those non-federal earth stations were installed so that the non-federal organizations could use the GOES system for the acquisition of critical data that may be utilized to protect life, property and commerce. As such, Microcom respectfully suggests that the Commission grant the same protection to non-federal earth stations receiving a NOAA downlink as is being proposed for federal ones. To this point, Microcom offers the following substantive comments for consideration.

Microcom believes the DCS is one of the most effective shared use systems operated by the federal Government, but this sharing extends beyond just federal agency to federal agency. In Title 15 CFR Part 911.1 paragraph (2) states …

> "For the purposes of this part, *user* refers to a private or governmental organization, whether for-profit or not for-profit, that owns or operates environmental data collection platforms for the purpose of collection and transmission of environmental data through the GOES DCS and for which a Federal agency or State or local government has a requirement for or interest in obtaining the data."

Further Part 911.2 (b)(1) states …

> "Except as provided in paragraph (b)(2) of this section, the GOES DCS is not to be used for data collection where adequate private common carrier communications exist to provide the service. (Adequate is defined in terms of capacity, speed and reliability with respect to the particular use envisioned). A user must document with a request for use of the GOES DCS, why private common carrier communications are not adequate."

Therefore, all data flowing through the DCS has been authorized by the Federal Government for use by the specific user and the Federal Government, e.g. the National Weather Service, and/or a State or Local Government. Therefore, Microcom respectfully suggests any authorized user of the DCS is a de facto extension of the Federal Government and entitled to the same incumbent protection for existing deployed and future earth stations.

While many non-federal users do operate their own earth station, it is Microcom's understanding that those that do, do so primarily for reliability reasons since the data is used to protect life and property. For example, Microcom has been working with the Florida Department of Transportation for many years to build out a weather monitoring system primarily focused on wind data that during times of tropical storms and hurricanes is used to determine when bridges and roads need to be closed in the interest of public safety. Obviously, closing a bridge to a barrier island as a hurricane approaches is a delicate and difficult task; close it too early and it could strand a significant population on the barrier island, close it too late and preventable accidents can occur on the bridge due to the extreme winds.

The FDOT system relies on the satellite based DCS to ensure that this critical data can be received during times of these extreme weather events. FDOT presently maintains DCS uplink sites in the Jacksonville area, the Florida Keys, and in the Florida panhandle; and is expected to continue to expand the system. FDOT also maintains two DCS earth stations; one in Lake City, Florida where based on historical data is the least wind impacted area in the state, and a second site at FDOT's Traffic Engineering Research Laboratory (TERL) in Tallahassee. The TERL site is used for testing and provides a backup to the primary earth station in Lake City.

When FDOT launched this project, it realized that it needed the most reliable way to collect this critical data and determined that using the GOES satellite, and specifically the Data Collection System, was the best approach to meet this objective; including installing a dedicated earth station that would be directly tied to the hardened FDOT microwave system. This resulted in a robust and reliable system to get this critical data to the impacted traffic centers when needed. The original data collection platforms were installed in 2012 and the earth stations were installed in 2013, and have served the citizens of Florida during numerous severe weather events.

During Hurricane Irma, the peak gust recorded from the data collection site on Big Pine Key was 174 MPH. The stations in the panhandle had just recently come online prior to Hurricane Matthew, and were able to provide both wind speed and water level data on key access ways. Further, as the DCS mandate in Title 15 Part 911 directs, the data flowing through FDOT's system is also available to the Federal Government. As such, during these two most recent hurricanes to hit Florida, the NWS was also able to utilize the data being collected from FDOT's system.

The Federal Highway Administration (FHWA) declared this FDOT project to be a "Best Practices", thereby recommending that other states consider implementing a similar system. Should other states wish to follow the recommendation of the FHWA, these states would most likely wish to install their own earth station.

The NOAA DCS clearly encourages non-federal use of the system to protect life and property. Accordingly, it is therefore in the public interest to protect any earth stations that are fulfilling such a mission, including those owned and operated by a non-federal agency.

Canadian and Mexican Coordination

Continuing the discussion on protecting non-federal sites and in response to section III.E.5.52 of the NPRM, it should also be noted that earth stations are utilized in both Canada and Mexico, as well as in several Caribbean countries. As such, Microcom was pleased to note that the Commission specifically noted the impact from the NPRM would cross international boundaries.

Presently, Microcom DCS earth station equipment is installed in four Canadian cities; Montreal, Ottawa, Gatineau, and Victoria. The first three cities are within 50 miles of the border, and Victoria is just a little over 10 miles from the border. All of these Canadian sites could undoubtedly be affected from the potential sharing of 1675-1680 MHz. Two of these sites are operated by the Canadian federal government, and the other two are operated by a power company, which Microcom believes is supported by the Canadian government.

Microcom also supplied earth station equipment for two sites in Mexico and five sites in the Caribbean, which may be further away from the US border, but could still be susceptible to interference from a terrestrial signal in 1675-1680 MHz; especially one being radiated from a tower with a peak power of 2000 Watts EIRP. Actually, the Caribbean site could be most affected due to the potential for thermal ducting over the water that could significantly extend the propagation of the signal as noted above.

As has been previously noted, these users have installed these ground stations because they have been authorized to use the DCS by the federal government, and the data they collect has been documented to be useful to the United States. As such, Microcom also recommends some form of protection for earth stations in these neighboring countries.

Microcom certainly understands that affording protection for all existing earth stations would, for a downlink sharing approach, significantly reduce the available geographic region for sharing as shown in Figure 5. In this diagram Microcom has shown the original 13 federal DCS earth stations and added those non-federal sites to which Microcom has supplied equipment.

Since there are two other brands of DCS earth station equipment there is certainly the potential for other DCS earth stations in the US and near its borders.

Further, this doesn't even take into account the numerous GRB and HRIT receive systems already in operation. While Microcom does not manufacture GRB receive systems, it does offer HRIT receivers in its product line. Microcom has over 50 HRIT receivers deployed; mostly in the US, but some also in Canada and in other countries.

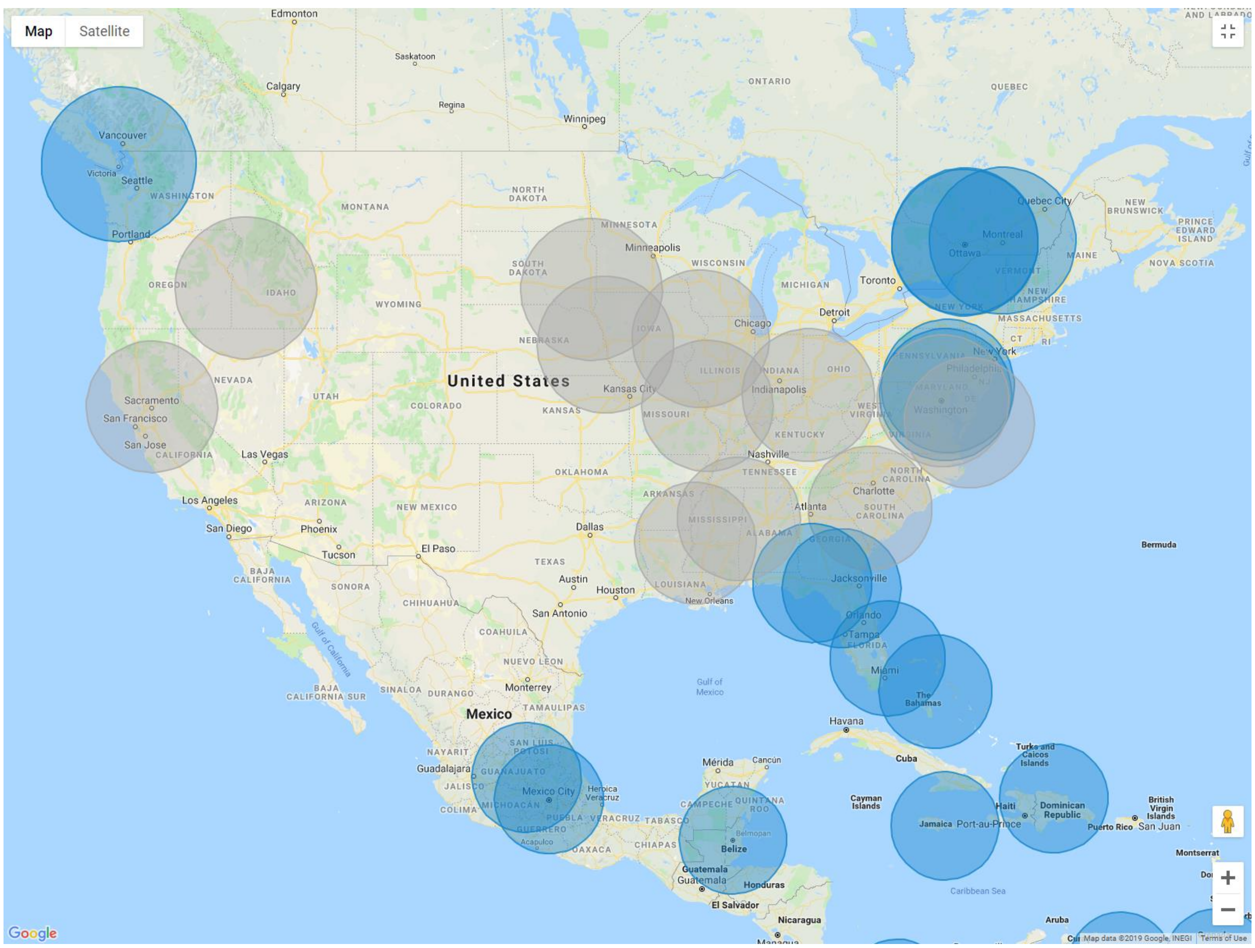

Figure 5: 200 Mile Radius Protection Zones Federal and Microcom Supplied DCS Earth Station

All of these earth stations could be protected by frequency and power limiting (i.e. use 1675-1679.7 MHz and uplink instead of downlink) while making a large geographic area available for wireless use. It does not take much imagination to envision how drastically the appearance of Figure 5 would change if the circles were drawn with a sub-mile radius.

Define Interference

Microcom would like to respond to paragraph III.B.17 to help define what constitutes harmful interference with respect to earth stations. Microcom is well positioned to provide expert advice on how interference should be defined based on its intimate knowledge of the GOES systems, and specifically the DCS.

First, it is our opinion that the Commission should state that if the new non-federal users are granted co-primary status; then under normal GOES operating conditions, the new non-federal users should have no standing to claim they are receiving interference from GOES. This will protect NOAA from having to address any claim of causing interference to a co-primary spectrum user by making changes to the spacecraft. On the other hand, interference from the new non-federal users may impact earth stations in novel ways which must be protected against.

Microcom can predict several ways the new non-federal users can cause interference with an earth station. Given that the GOES user community has never operated their satellite earth stations in a spectrum sharing environment as proposed by the NPRM, it would be prudent to help minimize confusion and unnecessary costs by helping to define what is to be considered interference to an earth station. It is recommended that NOAA maintain and update as necessary the definitions of interference, and provide this information to registered users of the GOES downlinks. In concert, the FCC would ensure the definitions of interference are enforced with new non-federal users of the band. Such an arrangement will minimize confusion for earth station users who are not experts at understanding the technical aspects of interference.

The most obvious definition of interference is when an earth station loses data or experiences an unacceptable increase in coded or un-coded bit-error rate (BER) due to the presence of another signal. However, there are other measurements of satellite link interference that Microcom believes should be defined, especially with regard to the DCS. Unlike the GRB or HRIT, which are continuous transmissions and where BER is a meaningful statistic, the DCS is a collection of individual short burst transmissions of varying lengths. Currently, in a typical 24 hour period, nearly 850,000 distinct transmissions or messages come through the DCS, and each one of these transmissions has a beginning and an end. Most transmissions are in the range of 3 to 10 seconds in total duration. For such a system, BER is not the best indicator of system performance and/or interference. Instead, earth station operational parameters such as phase noise and link margin can, and perhaps should, be used to indicate evidence of interference in a DCS receiver.

In the case of link margin, since the reliability of a GOES space-to-earth satellite link is tied directly to the link margin available for use during less than optimum propagation conditions, incumbent GOES spectrum users will need to regularly monitor the noise floor in the spectrum near their GOES signal to detect when new wireless users are reducing the margin below an acceptable minimum. When such a reduction occurs, an interference condition exists.

In the case of phase noise, interference energy can make it more difficult for an earth station receiver to detect data, and in extreme conditions, maintain phase synchronization to the transmitted signal. The phenomenon manifests itself as an increase in variance of the receiver's estimate of the relative phase of the received signal. Again, a margin is used, in this case, the acceptable increase in phase noise variance that will still maintain a reliable satellite link. If the acceptable increase is exceeded, an interference condition exists.

These measurements indicate interference but in-order to ensure the interference is due to a local event and is not inherent in the signal from the spacecraft there must be a known good signal to compare against. Therefore, it is recommended that a GOES receive site be created in a radio quiet zone for the express purpose of publishing real time signal metrics to be used by receive sites with potential interference events. This will provide the operators of earth stations the ability to verify any interference is local, and not systemic; thereby, removing any potential for a false reports of interference events.

Monitoring

Once the definition of interference is set the method for measuring and monitoring an earth station is the next logical part of the system that should be defined. Due to the fact that the terrestrial propagation of signals in the 1675-1680 MHz spectrum are subject to ducting, a monitoring system is necessary for either fixed or dynamic protection zones suggested in paragraph III.B.17 of the NPRM. The monitoring system should consist of receiving equipment with the ability to identify and locate interfering signals. When the interference negatively impacts the link margin or phase noise of a protected federal earth station, automatically triggering cessation of new non-federal operations in the band would certainly be preferred, but Microcom will defer to NOAA on its feasibility.

Reliability

In response to section III.B.20 of the NPRM regarding alternate means of data delivery, specifically an internet-based content delivery network (CDN), Microcom offers the following comments.

First, as noted in the NPRM, NOAA already makes many of its products available via the Internet. For example, all DCS data is currently available on the Internet, and many agencies do use the NOAA Internet feed as their primary source of DCS data. The obvious question then is why is it that some agencies, both federal and non-federal, do not use the existing Internet based system, and instead have installed a more costly earth station. The answer is reliability and dependency, especially in times of severe weather events.

Clearly the most reliable way for a user to obtain the data from remote data collection platforms is directly receiving the data from the GOES satellite using an earth station. The DCS transponder acts a "bent-pipe"; all DCS transmissions go up to the satellite in the UHF band (401.7-402.1 MHz), what is received at satellite is translated to the L-band downlink frequency (1679.7-1680.1 MHz), and relayed back down the Earth.

In other words, the only thing between the user and the data coming from the remote site is the GOES spacecraft itself. While the user obviously depends on NOAA to provide the GOES satellite, there is no other dependency in this scenario. Further, if the satellite is not there, it doesn't matter what delivery system is used since NOAA itself cannot receive the data.

Any claim that an Internet-based CDN, or any other alternate delivery system, can be as reliable as a locally installed receive station, which gets its data directly from the satellite defies common sense. First off, any other delivery system requires that NOAA receive the data via its earth station, after which there are numerous systems the data must flow through to even begin the process of an alternate delivery mechanism.

Every component in a system has a measurable failure rate, and the more non-redundant components there are in a system the lower the reliability of the system. Further, the more systems a piece of data must pass through to get to the end user, the lower the reliability of being able to receive the data. Obviously, a CDN only adds components to the system and will therefore lower the reliability.

Naturally, the counter to this argument is redundancy. By installing redundant components performing identical or backup functions, the overall redundancy of a system can be improved. Microcom simply does not believe this has been adequately demonstrated at this time for the proposed CDN.

Also, what cannot be countered is the dependency factor. Utilizing a delivery mechanism that depends on systems outside of an agency's control clearly makes the agency's mission dependent on that system. Utilizing an earth station helps to reduce or eliminate this outside dependency.

Microcom provides a variety of telemetry solutions to allow users to get their data. In addition to providing earth stations, Microcom offers, and has provided, Internet-based software for data collection. Not too surprisingly, Microcom's software is less costly than its earth stations, and for some users this software/Internet based approach makes the most sense.

Most users who have purchased a Microcom earth station have a mission that includes protecting life, property, and/or commerce (e.g. NIFC, USACE, FDOT, etc.). For these missions, clearly the most reliable approach is what is desired, and it is certainly not Microcom's place to direct them otherwise; Microcom provides the various options and the users choose what is believed to be best for their mission.

Potential Impact to Microcom

Before closing, Microcom would like to take this opportunity to present some potential issues that would specifically affect its corporate operations. Microcom is obviously concerned that DCS earth stations will be rendered useless due to a strong terrestrial broadcast that would overlay the DCS bandwidth. Microcom is naturally concerned from the standpoint of loss of revenue to Microcom, but also from being able to continue to provide support to agencies that have missions that protect life, property, and commerce.

Since Microcom's receive equipment is the basis of the NOAA ground stations, as well as many other federal sites, Microcom operates and maintains two DCS earth stations (one for GOES-East and one for GOES-West), as well as HRIT earth stations. If the Commission does not take steps to protect all earth stations, Microcom's systems will undoubtedly no longer be useable. Such a scenario would make it exceedingly difficult continue to support the ongoing missions of the protected federal earth stations.

Any sharing approach that renders future ground stations suspect will most likely end Microcom's earth station business. However, beyond the potential loss of new earth station contracts, the loss of a reliable downlink could also negatively impact the expected growth of the DCS completely, and compromise Microcom's future DCS transmitter business as well.

The DCS is not static by any means; the system has grown substantially in the past 20 years since Microcom began to develop its product line. When Microcom first installed the earth station equipment at NOAA's Wallops Command and Data Acquisition Station in November of 2003, there were just over 10,000 active DCPs, now there are approximate 30,000.

In 2009, NOAA adopted a new modulation format for the DCS uplink transmitters that will ultimately double the channel capacity without increasing the total bandwidth, i.e. the individual channel bandwidth was cut in half. While the new modulation format dates back ten years, this expansion of the DCS is just beginning to happen since the legacy versions of the transmitters have to be replaced or upgraded before the use of the new channels can be realized. Any sharing plan that jeopardizes the DCS downlink, could impact this growth and the potential future transmitter business for Microcom, and its competitors.

Conclusion

In conclusion, Microcom hopes it has demonstrated that it supports spectrum efficiency and safe-sharing of the 1675-1680 MHz band. Microcom also hopes that is has conveyed what it knows to be true; that GOES DCS, GRB and HRIT downlinks are critical parts of this country's weather infrastructure and serves the citizens of this country by protecting life, property, and commerce. Any sharing plan that negatively impacts this infrastructure is clearly not in the public interest.

Microcom respectfully suggests that the best way to insure safe-sharing and maximum use of 1675-1680 MHz consists of three key components:

1. Primary/Secondary status instead of Co-Primary.
2. Uplink instead of downlink wireless utilization.
3. Spectral limiting to avoid a co-channel situation.

These three factors will minimize the potential for interference, allow protection of non-federal as well as federal earth stations, simplify the addition of new earth stations, and maximum the geographic use of the spectrum by new wireless licensees.

Respectfully,

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